Time-of-Flight Ultra-Small-Angle Neutron Scattering Instrument (TOF-USANS) for SNS

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We present a preliminary concept of a Bonse-Hart-type Time-of-Flight Ultra-Small-Angle Neutron Scattering (TOF-USANS) Double-Crystal Diffractometer (DCD) adapted for use at pulsed neutron sources. The experimental set up for this instrument is in principle similar to that designed for the conventional Ultra Small Angle Neutron Scattering (C-USANS) instruments with triple-bounce channel-cut crystals, however usage of the TOF technique allows separating of several higher order Bragg-reflected wavelengths arriving at the detector. This gives an opportunity to obtain several USANS data simultaneously, which gives significant intensity gain and makes the instrument competitive with the best conventional USANS instruments now in use at steady operational reactor sources. Besides, the proposed instrument allows working simultaneously with different Q-resolution at each separated wavelength using the fact that the Darwin width is proportional to the square of wavelength. This effect makes it possible to increase the real space upper resolution limit of the instrument compared to conventional USANS cameras, as well as extend the USANS Q-range to the larger Q values.

Silicon, which is mostly in use for the dynamical diffraction studies, is chosen as a material of channel-cut crystals for the first variant of TOF-USANS mock up, which we plan to design and test at Argonne's Intense Pulsed Neutron Source. The further development in this field will be connected with an attempt to replace Si with other single crystals with larger d-spacing. The latter allows the further increase of the Darwin width, which leads to increase of the number of useful high order Bragg-reflections and as a result to the effectiveness of the proposed instrument.